INCH-POUND

MIL-PRF-19500/687
14 March 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS) TRANSISTOR, N-CHANNEL SILICON
TYPES 2N7509, 2N7510, AND 2N7511 JANTXVD, R AND JANSD, R

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for a N-Channel, enhancement-mode, MOSFET, radiation hardened (total dose and single event effects (SEE) characterization), power transistor intended for use in high density power switching applications. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, TO-254.

1.3 Maximum ratings. T_A = +25°C, unless otherwise specified.

Type	P_T (1) T_C = +25°C	V_{DS}	V_{DG}	V_{GS}	I_{D1} (2) T_C =+25°C	I_{D2} (2) T_C = +100°C	I_S (2)	I_{DM}	T_J and T_{STG}	V_{ISO} 70,000 ft. altitude
	W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C	V dc
2N7509	192	100	100	±30	70	55	70	200	-55	N/A
2N7510	192	200	200	±30	53	34	53	200	to	N/A
2N7511	192	250	250	±30	42	27	42	160	+150	250

(1) Derate linearly 1.54 W/°C for T_C > +25°C; $P_T = (T_{jmax} - T_C)/R_{\theta JC}$

(2) $I_D = ((T_{jmax} - T_C)/((R_{\theta JC})X(r_{DS(on)} \text{ at } T_{jmax})))^{1/2}$

1.4 Primary electrical characteristics at T_C = +25°C.

Type	Min $V_{(BR)DSS}$ V_{GS} = 0 I_D = 1.0 mA dc	$V_{GS(TH)1}$ $V_{DS} = V_{GS}$ I_D = 1.0 mA dc		Max I_{DSS1} V_{GS} = 0 V_{GS} = 80% of rated V_{DS}	Max $r_{DS(on)}$ (1) V_{GS} = 12V		$R_{\theta JC}$ max	I_{AS}
					T_J = 25°C at I_{D2}	T_J = 125°C at I_{D2}		
	V dc	V dc Min	V dc Max	µA dc	Ω	Ω	°C/W	A (pk)
2N7509	100	2.0	4.5	25	0.014	0.026	0.65	170
2N7510	200				0.034	0.065		110
2N7511	250				0.049	0.096		85

(1) Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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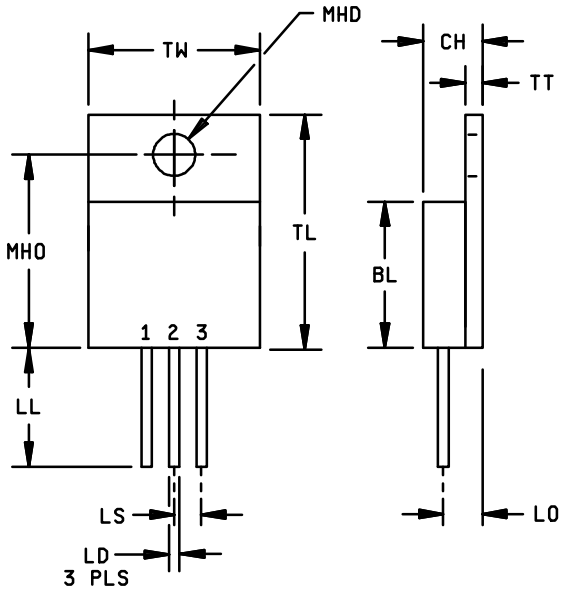

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
CH	0.249	0.260	6.32	6.60
TT	0.040	0.050	1.02	1.27
LO	0.150 BSC		3.81 BSC	
LD	0.035	0.045	0.89	1.14
TL	0.790	0.800	20.07	20.32
BL	0.535	0.545	13.59	13.84
LS	0.150 BSC		3.81 BSC	
TW	0.535	0.545	13.59	13.84
LL	0.52	0.56	13.21	14.22
MHO	0.665	0.685	16.89	17.40
MHD	0.139	0.149	3.53	3.78
Term 1	Drain			
Term 2	Source			
Term 3	Gate			

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. All terminals are isolated from case.
4. Die to base is BeO isolated, terminals to case ceramic (AL_2O_3) isolated.
5. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions for TO-254.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Service (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1. General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2. Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3. Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1(TO-254) herein. Nominal weight percent of lead material shall be 99.80 percent copper (Cu) and 0.20 percent zirconium (Zr).

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking of the country of origin may be omitted from the body of the transistor but shall be retained on the initial container.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in paragraph 1.3, 1.4, and table I.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3 herein.

3.8 Electrostatic discharge protection. The devices covered by this specification require electrostatic discharge protection.

3.8.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. However, the following handling practices are recommended.

a. Devices should be handled on benches with conductive handling devices.

b. Ground test equipment, tools and personnel handling devices.

c. Do not handle devices by the leads.

d. Store devices in conductive foam or carriers.

e. Avoid use of plastic, rubber or silk in MOS areas.

f. Maintain relative humidity above 50 percent if practical.

g. Care should be exercised during test and troubleshooting to apply not more than maximum rated voltage to any lead.

h. Gate must be terminated to source, R $\leq$ or 100 k ohms, whenever bias voltage is applied drain to source.

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500. Alternate flow is allowed for qualification inspection in accordance with figure 4 of MIL-PRF-19500.

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500, and table II herein. End-point electrical measurements shall be in accordance with the applicable steps of table IV herein.

4.3 Screening. Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement JANS	Measurement JANTXV
(1)	Method 3470 E_{AS} test (see 4.5.4)	Method 3470 E_{AS} test (see 4.5.4)
(1)	Method 3161 (see 4.5.3)	Method 3161 (see 4.5.3)
(1)	Gate stress test (see 4.5.5)	Gate stress test (see 4.5.5)
(2)	Subgroup 2 of table I herein	Subgroup 2 of table I herein
9	I_{GSS}, I_{DSS1} as a minimum	I_{GSS}, I_{DSS1} as a minimum
10	Method 1042 of MIL-STD-750, test condition B	Method 1042 of MIL-STD-750, test condition B
11	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(ON)}$, $V_{GS(TH)}$ Subgroup 2 of table I herein. ΔI_{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{DSS1} = ±25 µA dc or ±100 percent of initial value, whichever is greater.	I_{GSSF1}, I_{GSSR1}, I_{DSS1}, $r_{DS(ON)}$, $V_{GS(TH)}$ Subgroup 2 of table I herein.
12	Method 1042 of MIL-STD-750, test condition A, 240 hours minimum.	Method 1042 of MIL-STD-750, test condition A, 160 hours minimum.
13	Subgroups 2 and 3 of table I herein ΔI_{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{DSS1} = ±25µA dc or ±100 percent of initial value, whichever is greater. $\Delta r_{DS(ON)1}$ = ±20 percent of initial value. $\Delta V_{GS(TH)1}$ = ±20 percent of initial value.	Subgroup 2 of table I herein ΔI_{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI_{DSS1} = ±25µA dc or ±100 percent of initial value, whichever is greater. $\Delta r_{DS(ON)1}$ = ±20 percent of initial value. $\Delta V_{GS(TH)1}$ = ±20 percent of initial value.

(1) Shall be performed anytime before screen 10.

(2) Shall be performed after E_{AS} test, method 3161, and gate stress test.

4.4 Conformance. Conformance inspection shall be in accordance with MIL-PRF-19500. Alternate flow is allowed for conformance inspection in accordance with figure 4 of MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) and in table VIb (JANTXV) of MIL-PRF-19500, and 4.4.2.1 and 4.4.2.2 herein. Electrical measurements (end-points) shall be in accordance with table 1, group A, subgroup 2 herein. Delta V_{SD} measurements shall be in accordance with table IV herein.

4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1051	Test condition F or G, 100 cycles.
B4	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. t_{on} = 30 seconds minimum.
B5	1042	Accelerated steady-state reverse bias, condition A.
B5	1042	Accelerated steady-state gate bias, condition B.
B6	3161	Thermal resistance, see 4.5.2.

4.4.2.2 Group B inspection, table Vib (JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. t_{on} = 30 seconds minimum.
B5	3161	Thermal resistance, see 4.5.2.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table IV herein.

Subgroup	Method	Condition
C2	2036	Terminal strength, test condition A, weight = 10 pounds, t = 15 seconds.
C6	1042	Intermittent operation life, condition D, 6,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. t_{on} = 30 seconds minimum.

4.4.4 Group D inspection. Group D inspection shall be conducted in accordance with table VIII of MIL-PRF-19500 and table III herein.

4.4.4.1 Design parameters. Not tested on a per lot basis. Design shall be such that the devices shall be capable of meeting the requirements in SEE safe operating area graphs.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of $R_{\theta JC}$ = 0.65 °C/W. The following parameters shall apply:

a. Measuring current(I_M)..... 10 mA.

b. Drain heating current (I_H)..... 4 A.

c. Heating time (t_H)..... Steady-state (see method 3161 of MIL-STD-750).

d. Drain-source heating voltage (V_H)..... 25 V.

e. Measurement time delay (t_{MD})..... 30 to 60 µs.

f. Sample window time (t_{SW})..... 10 µs maximum.

4.5.3 Thermal response (V_{SD} measurement). The delta V_{SD} measurement shall be performed in accordance with method 3161 of MIL-STD-750. The delta V_{SD} conditions (I_H and V_H) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 2) and shall be specified in the certificate of conformance prior to qualification. The following parameter measurements shall apply:

a. Measuring current (I_M)..... 10 mA.

b. Drain heating current (I_H)..... 4 A.

c. Heating time (t_H)..... 100 ms.

d. Drain-source heating voltage (V_H)..... 25 V.

e. Measurement time delay (t_{MD})..... 30 - 60 µs.

f. Sample window time (t_{SW})..... 10 µs maximum.

4.5.4 Single pulse avalanche energy (E_{AS}).

a. I_{AS} shall be as specified in 1.4 herein.

b. L = 0.1 mH.

c. Gate to source resistor (25 ohms $\leq R_{GS} \leq$200 ohms).

d. $E_{AS} = 1/2\ LI_{AS}^2$.

e. V_{DD} = 50 V to 150 V dc.

f. Initial junction temperature = 25°C, -5°C, +10°C.

4.5.5 Gate stress test.

a. V_{GS} = 45 V.

b. t = 250 µs, minimum.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Units
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Breakdown voltage drain to source	3407	V_{GS} = 0V, I_D = 1 mA dc, bias condition C	$V_{(BR)DSS}$			
2N7509				100		V dc
2N7510				200		V dc
2N7511				250		V dc
Gate to source voltage (threshold)	3403	V_{DS} = V_{GS}, I_D = 1 mA dc	$V_{GS(TH)1}$	2.0	4.5	V dc
Gate current	3411	V_{GS} = ±30V dc, bias condition C, V_{DS} = 0V	I_{GSS1}		±100	nA dc
Drain current	3413	V_{GS} = 0V dc, bias condition C, V_{DS} = 80 percent of rated V_{DS}	I_{DSS1}		25	µA dc
Static drain to source "ON" state resistance	3421	V_{GS} = 12V dc, condition A, pulsed (see 4.5.1), I_D = I_{D2}	$r_{DS(ON)1}$		0.014	Ω
2N7509					0.034	Ω
2N7510					0.049	Ω
2N7511						
Static drain to source "ON" state voltage	3405	V_{GS} = 12V dc, condition A, pulsed (see 4.5.1), I_D = I_{D1}	$V_{DS(ON)}$		1.010	V dc
2N7509					1.91	V dc
2N7510					2.18	V dc
2N7511						
Forward voltage	4011	V_{GS} = 0V dc, condition A, pulsed (see 4.5.1), I_D = I_{D1}	V_{SD}		1.2	V dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Units
	Method	Conditions		Min	Max	
Subgroup 3						
High temperature operation		$T_C = T_J = +125^{\circ}C$				
Gate current	3411	$V_{GS} = \pm 30V$ dc, bias condition C, $V_{DS} = 0V$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0V$ dc, bias condition C, V_{DS} = 80 percent of rated V_{DS}	I_{DSS2}		0.250	mA dc
Static drain to source "ON"-state resistance	3421	$V_{GS} = 12V$ dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)2}$			
2N7509					0.026	Ω
2N7510					0.065	Ω
2N7511					0.096	Ω
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$, $I_D = 1$ mA dc	$V_{GS(TH)2}$	1.0		V dc
Low temperature Operation		$T_C = T_J = -55^{\circ}C$				
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$, $I_D = 1$ mA dc	$V_{GS(TH)3}$		5.5	V dc
Subgroup 4						
Switching time test	3472	$I_D = I_{D1}$, $V_{GS} = 12$ V dc, $R_G = 2.35\ \Omega$, V_{DD} = 50 percent of rated V_{DS}				
Turn-on delay time			$t_{D(on)}$			
2N7509					35	ns
2N7510					35	ns
2N7511					35	ns
Rise time			t_R			
2N7509					140	ns
2N7510					140	ns
2N7511					70	ns

See footnote at end of table.

TABLE I. Group A inspection – Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Units
	Method	Conditions		Min	Max	
Subgroup 4 – Cont.						
Turn-off delay time			$t_{D(off)}$			
2N7509					60	ns
2N7510					65	ns
2N7511					70	ns
Fall time			t_f			
2N7509					20	ns
2N7510					15	ns
2N7511					15	ns
Subgroup 5						
Safe operating area test (high voltage)	3474	See figure 3, t_p = 10 ms min. V_{DS} = 80 percent of max. rated V_{DS} ($V_{DS} \leq$ 200 V)				
Electrical measurements		See table IV, steps 1, 2, 3, 4, 5, 6, and 7				
Subgroup 6						
Not applicable						
Subgroup 7						
Gate charge	3471	Condition A or B				
On-state gate charge			$Q_{G(ON)}$			
2N7509					150	nC
2N7510					115	nC
2N7511					115	nC
Gate to source charge			Q_{GS}			
2N7509					45	nC
2N7510					60	nC
2N7511					45	nC

See footnote at end of table.

TABLE I. Group A inspection – Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Units
	Method	Conditions		Min	Max	
Subgroup 7 - Continued.						
Gate to drain charge			Q_{GD}			
2N7509					55	nC
2N7510					30	nC
2N7511					45	nC
Reverse recovery time	3473	di/dt = 100 A/µs, $V_{DD} \leq 50$ V, $I_D = I_{D1}$	t_{rr}		300	ns
2N7509					370	ns
2N7510					590	ns
2N7511						

1/ For sampling plan, see MIL-PRF-19500.

TABLE II. Group E inspection (all quality levels) - for qualification only.

Inspection 1/ 2/ 3/ 4/ 5/	MIL-STD-750		Qualification and large lot conformance inspection
	Method	Conditions	
Subgroup 1			12 devices c = 0
Temperature cycling (air to air)	1051	Test condition F or G, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table IV, steps 1, 2, 3, 4, 5, 6, and 7	
Subgroup 2 1/			12 devices c = 0
Steady-state gate bias	1042	Test condition B; 1,000 hours	
Electrical measurements		See table IV, steps 1, 2, 3, 4, 5, 6, and 7	
Steady state reverse bias	1042	Test condition A; 1,000 hours	
Electrical measurements		See table IV, steps 1, 2, 3, 4, 5, 6, and 7.	
Subgroup 3			
Not applicable			
Subgroup 4			22 devices c = 0
Thermal resistance	3161	$R_{\theta JC}$ = 0.65 °C/W maximum. See 4.5.2.	
Subgroup 5			15 devices c = 0
Barometric pressure test (not required for $V_{BR(DSS)} \leq 200$ V)	1001	Test condition C	
2N7511		V_{DS} = 250 V; $I_{(ISO)} < 0.25$ mA	

See footnotes at end of table.

TABLE II. Group E inspection (all quality levels) - for qualification only - Continued.

Inspection 1/ 2/ 3/ 4/ 5/	MIL-STD-750		Qualification and large lot conformance inspection
	Method	Conditions	
Subgroup 6			5/ 3 devices c = 0
Electrical measurements 3/		See table IV, steps 3 and 4	
SEE testing 4/ (see figure 4)	1080	Fluence = 3e5 ± 20 percent ions/cm^2 Flux = 5e3 to 2e4 ions/cm^{2}sec Beam energy = 260 to 360 MeV Temperature = 25°C ± 5°C	
2N7509		LET = 36 to 40 MeV-cm^2/mg Ion range = 35 to 40 microns Insitu bias conditions: V_{DS} = 100 V and V_{GS} = -10 V LET = 56 to 60 MeV-cm^2/mg Ion range = 30 to 35 microns Insitu bias conditions: V_{DS} = 100 V and V_{GS} = -2 V V_{DS} = 50 V and V_{GS} = -8 V LET = 80 to 84 MeV-cm^2/mg Ion range = 25 to 30 microns Insitu bias conditions: V_{DS} = 80 V and V_{GS} = 0 V V_{DS} = 50 V and V_{GS} = -5 V	
2N7510		LET = 36 to 40 MeV-cm^2/mg Ion range = 35 to 40 microns Insitu bias conditions: V_{DS} = 200 V and V_{GS} = -20 V LET = 56 to 60 MeV-cm^2/mg Ion range = 30 to 35 microns Insitu bias conditions: V_{DS} = 200 V and V_{GS} = -10 V LET = 80 to 84 MeV-cm^2/mg Ion range = 25 to 30 microns Insitu bias conditions: V_{DS} = 160 V and V_{GS} = -5 V V_{DS} = 120 V and V_{GS} = -10 V	

See footnotes at end of table.

TABLE II. Group E inspection (all quality levels) - for qualification only - Continued.

Inspection 1/ 2/ 3/ 4/ 5/	MIL-STD-750		Qualification and large lot conformance inspection
	Method	Conditions	
2N7511		LET = 36 to 40 MeV-cm^2/mg Ion range = 35 to 40 microns Insitu bias conditions: V_{DS} = 250 V and V_{GS} = -20 V LET = 56 to 60 MeV-cm^2/mg Ion range = 30 to 35 microns Insitu bias conditions: V_{DS} = 250 V and V_{GS} = -10 V LET = 80 to 84 MeV-cm^2/mg Ion range = 25 to 30 microns Insitu bias conditions: V_{DS} = 200 V and V_{GS} = -5 V V_{DS} = 150 V and V_{GS} = -10 V	
Subgroup 6			3 devices c = 0
Electrical measurements 3/		See table IV, steps 3 and 4	
Electrostatic discharge protection (ESD)	1020		

1/ A separate sample for each test may be pulled.
2/ Group E qualification of single event effect testing may be performed prior to lot formation. Wafers qualified to these group E QCI requirements may be used for any other performance specification utilizing the same die design.
3/ As a minimum, gate to source leakages and drain to source leakage are to be examined to verify the electrical performance of the DUT prior to and after test. At the manufacturer's option, the remaining static tests in table IV, with the exception of step 8, may be performed.
4/ Devices passing a given combination of drain and gate voltage for an LET of 80 to 84 MeV-cm^2/mg qualify the same conditions for an LET of 56 to 60 MeV-cm^2/mg or an LET of 36 to 40 MeV-cm^2/mg.
5/ This sampling plan applies to each bias condition specified.

TABLE III. Group D inspection.

Inspection 1/ 2/ 3/ 4/ 5/	MIL-STD-750		Symbol	Pre-irradiation limits		Post irradiation limits		Units
	Method	Conditions		Min.	Max.	Min.	Max.	
Subgroup 1								
Not applicable								
Subgroup 2		T_C = +25°C						
Steady state total dose irradiation (V_{GS} bias)	1019	V_{GS} = 12V, V_{DS} = 0V						
Steady state total dose irradiation (V_{DS} bias)	1019	V_{GS} = 0V, V_{DS} = 80 percent of rated V_{DS}						
Breakdown voltage drain to source	3407	V_{GS} = 0V, I_D = 1 mA dc, bias condition C	$V_{(BR)DSS}$					
2N7509				100		100		V dc
2N7510				200		200		V dc
2N7511				250		250		V dc
Gate to source voltage (threshold)	3403	V_{DS} = V_{GS}, I_D = 1 mA dc	$V_{GS(TH)1}$	2.0	4.5	2.0	4.5	V dc
Gate current	3411	V_{GS} = ±30V dc, V_{DS} = 0V, bias condition C	I_{GSS1}		±100		±100	nA dc
Drain current	3413	V_{GS} = 0V, V_{DS} = 80 percent of rated V_{DS}, bias condition C	I_{DSS1}		25		25	µA dc
Static drain to source "ON"-state resistance	3421	V_{GS} =12V dc, condition A, pulsed (see 4.5.1), I_D = I_{D2}	$r_{DS(ON)1}$					
2N7509					0.014		0.014	Ω
2N7510					0.034		0.034	Ω
2N7511					0.049		0.049	Ω
Static drain to source "ON"-state voltage	3405	V_{GS} = 12V dc, condition A, pulsed (see 4.5.1), I_D = I_{D1}	$V_{DS(ON)}$					
2N7509					1.010		1.010	V dc
2N7510					1.91		1.91	V dc
2N7511					2.18		2.18	V dc

1/ For sampling plan see MIL-PRF-19500.
2/ Electrical specifications are for 'D' and 'R' rad levels.
3/ Group D qualification may be performed prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other detail specification utilizing the same die design.
4/ Separate samples shall be pulled for each bias.
5/ At the manufacturer's option, group D samples need not be subjected to all the screening tests, but shall be assembled in its qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

TABLE IV. Group A, B, C and E electrical measurements.

Step	Inspection 1/ 2/	MIL-STD-750		Symbol	Limits		Units
		Method	Conditions		Min	Max	
1.	Breakdown voltage drain to source	3407	V_{GS} = 0V, I_D = 1 mA dc, bias condition C	$V_{(BR)DSS}$			
	2N7509				100		V dc
	2N7510				200		V dc
	2N7511				250		V dc
2.	Gate to source voltage (threshold)	3403	V_{DS} = V_{GS}, I_D = 1 mA dc	$V_{GS(TH)1}$	2.0	4.5	V dc
3.	Gate current	3411	V_{GS} = ±30V dc, bias condition C, V_{DS} = 0V	I_{GSS1}		±100	nA dc
4.	Drain current	3413	V_{GS} = 0V dc, bias condition C, V_{DS} = 80 percent of rated V_{DS}	I_{DSS1}		25	µA dc
5.	Static drain to source "ON"-state resistance	3421	V_{GS} = 12V dc, condition A, pulsed (see 4.5.1), I_D = I_{D2}	$r_{DS(ON)1}$			
	2N7509					0.014	Ω
	2N7510					0.034	Ω
	2N7511					0.049	Ω
6.	Static drain to source "ON"-state voltage	3405	V_{GS} = 12V dc, condition A, pulsed (see 4.5.1), I_D = I_{D1}	$V_{DS(ON)}$			
	2N7509					1.010	V dc
	2N7510					1.91	V dc
	2N7511					2.18	V dc
7.	Forward voltage	4011	V_{GS} = 0V dc, condition A, pulsed (see 4.5.1), I_D = I_{D1}	V_{SD}		1.2	V dc
8.	Thermal response	3161	See 4.5.3	ΔV_{SD}		100	mV

1/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:
- a. Subgroup 3, see table IV herein, steps 1, 2, 3, 4, 5, 6, and 7.
- b. Subgroup 4, see table IV herein, steps 1, 2, 3, 4, 5, 6, 7, and 8.
- c. Subgroup 5, see table IV herein, steps 1, 2, 3, 4, 5, 6, and 7.

2/ The electrical measurements for table VII of MIL-PRF-19500 are as follows:
- a. Subgroup 2 and 3, see table IV herein, steps 1, 2, 3, 4, 5, 6, and 7.
- b. Subgroup 6, see table IV herein, steps 1, 2, 3, 4, 5, 6, 7, and 8.

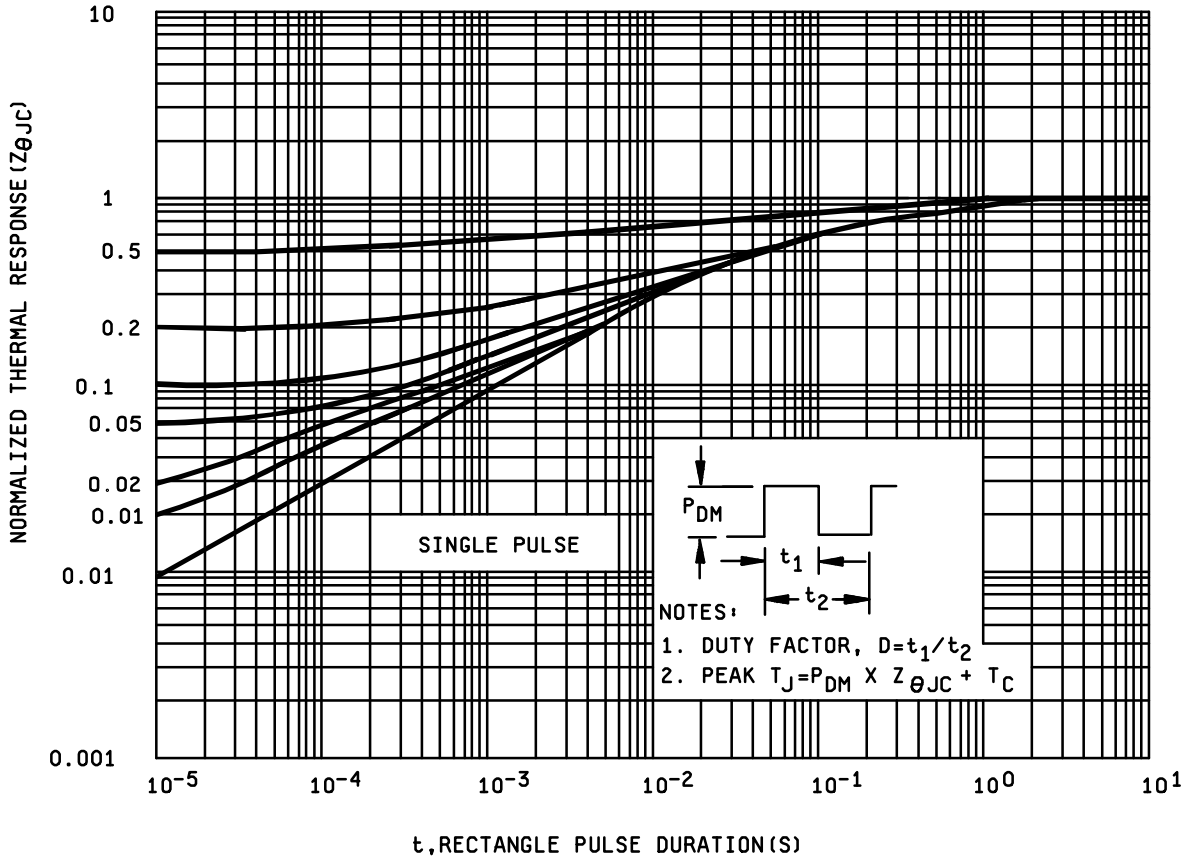

FIGURE 2. Thermal response curves.

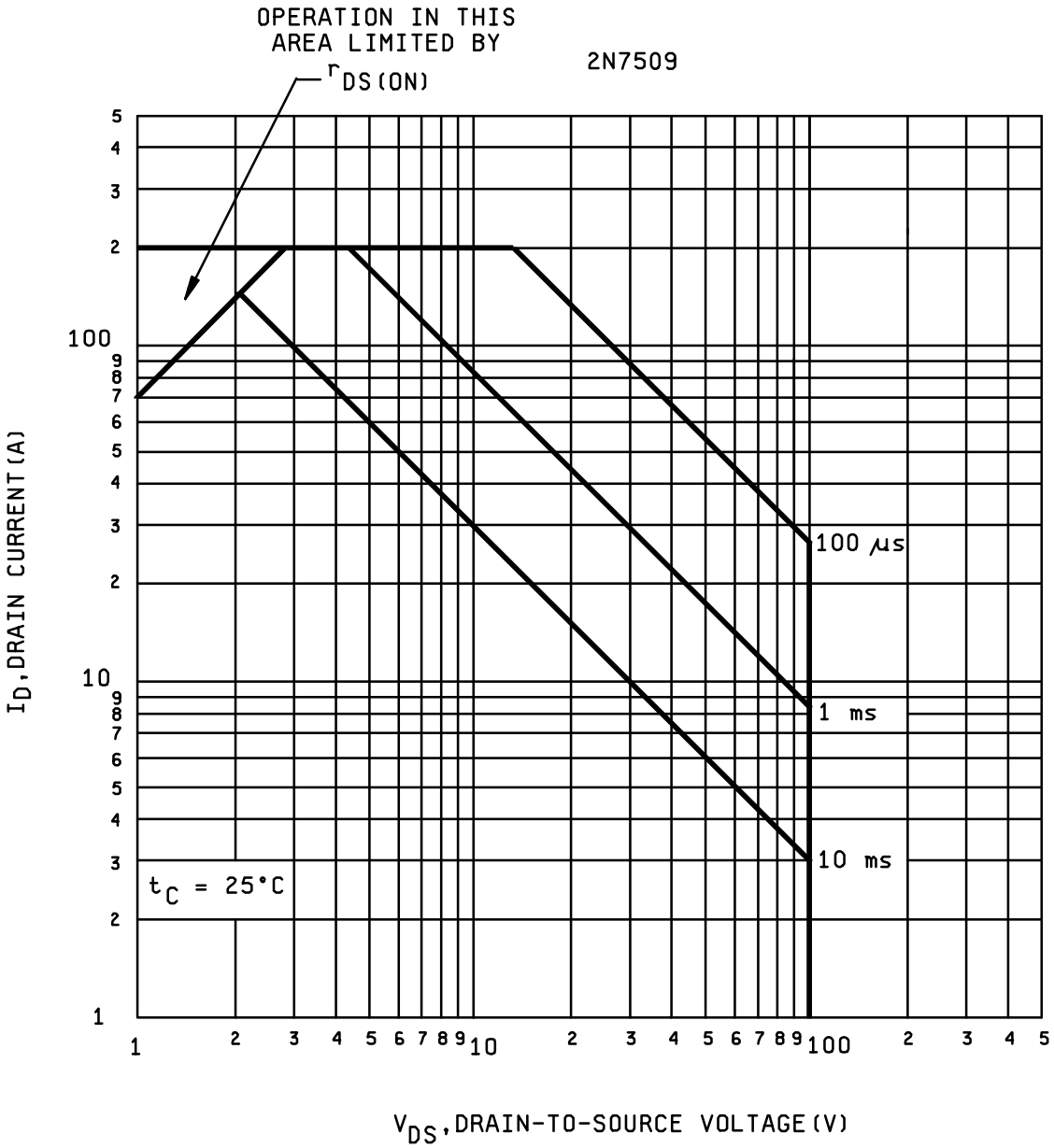

FIGURE 3. Safe operating area graphs.

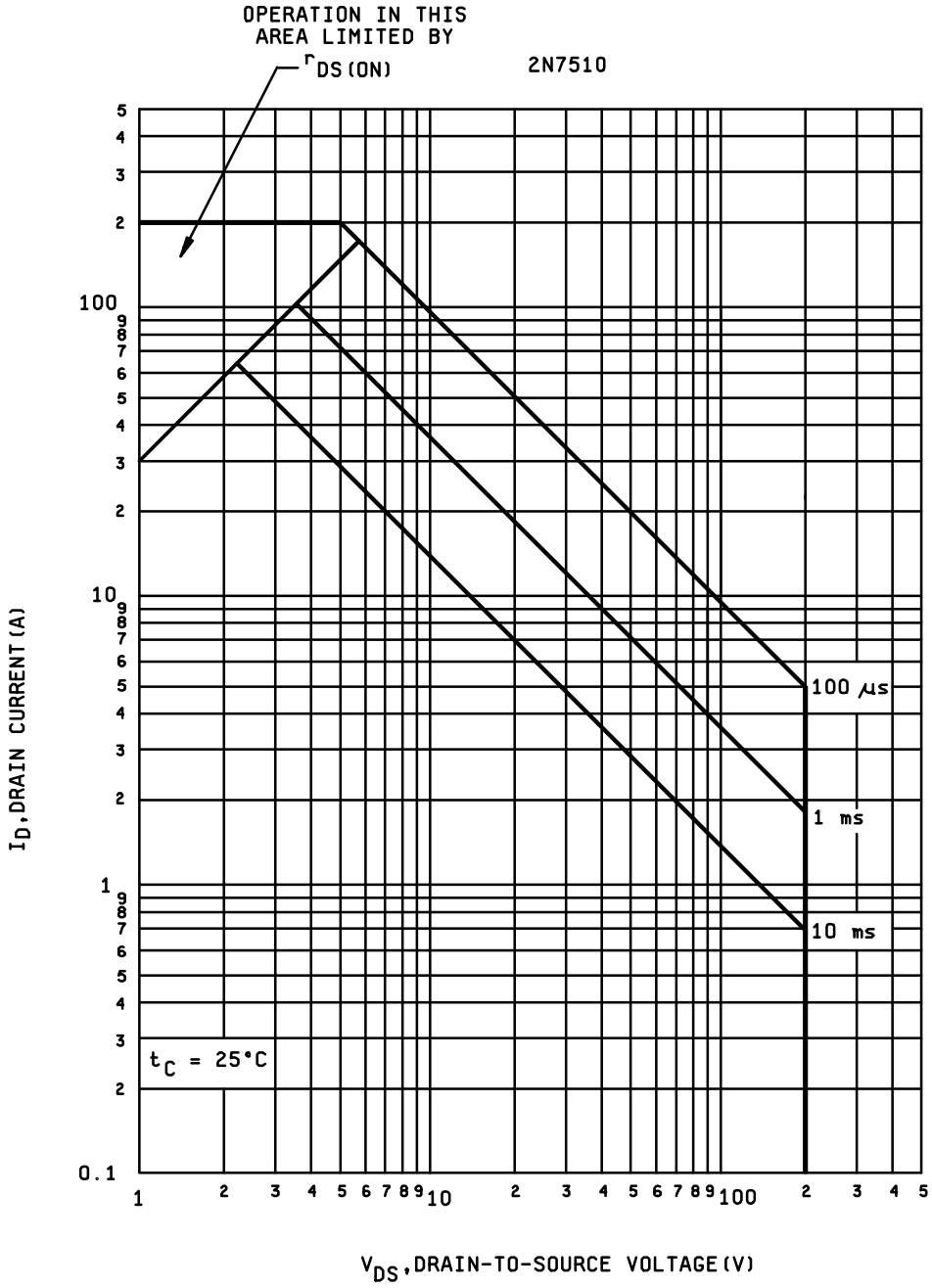

FIGURE 3. Safe operating area graphs –continued.

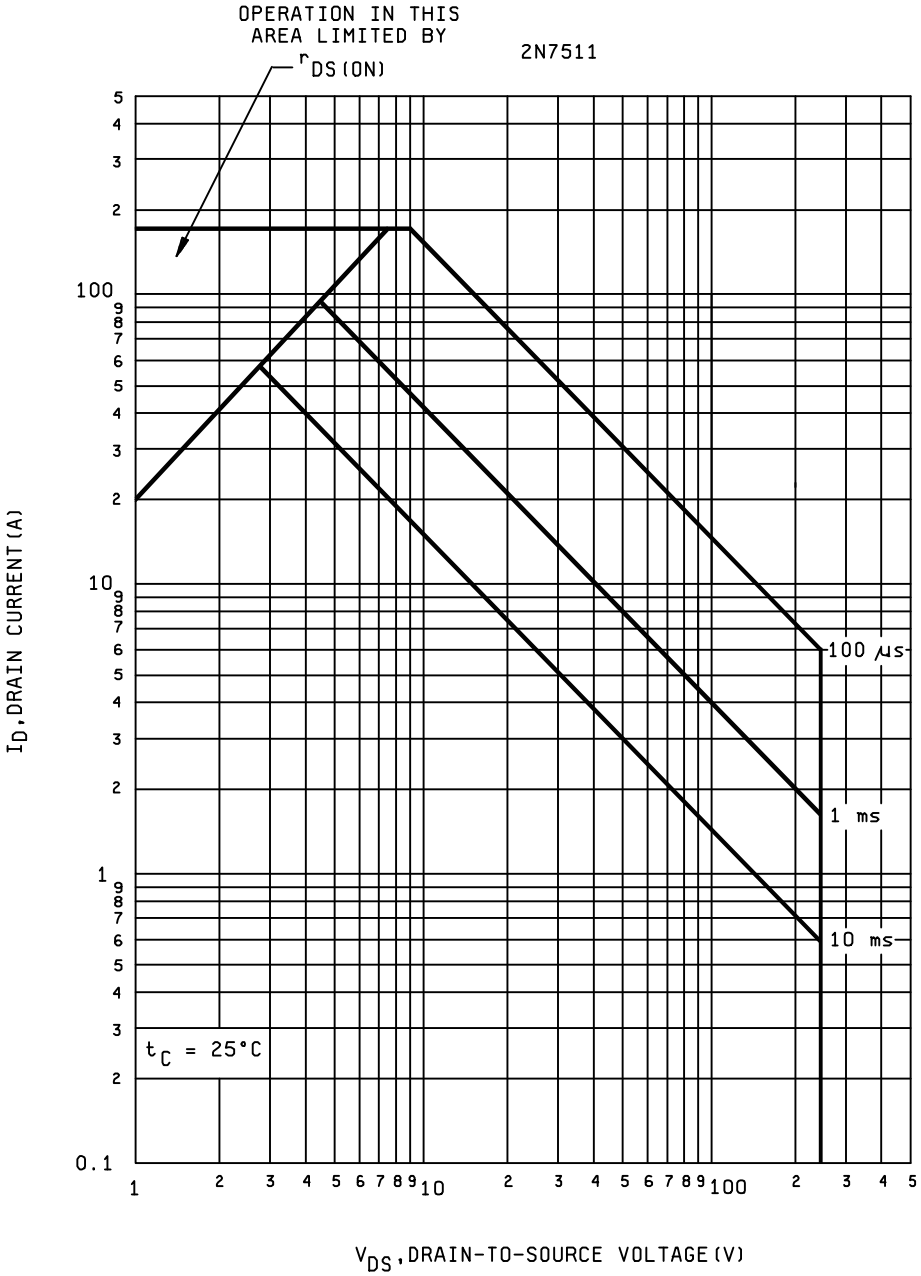

FIGURE 3. Safe operating area graphs – Continued.

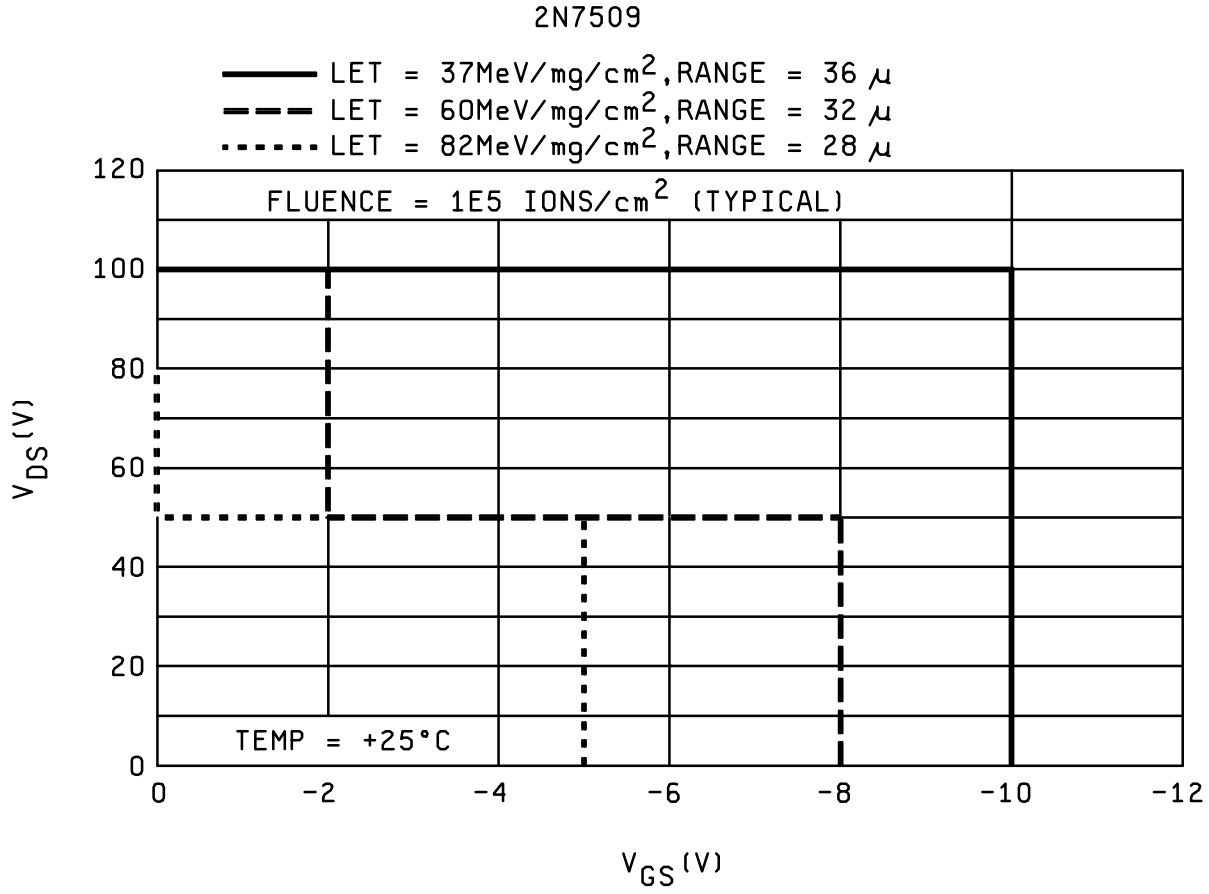

FIGURE 4. SEE safe operating area graphs.

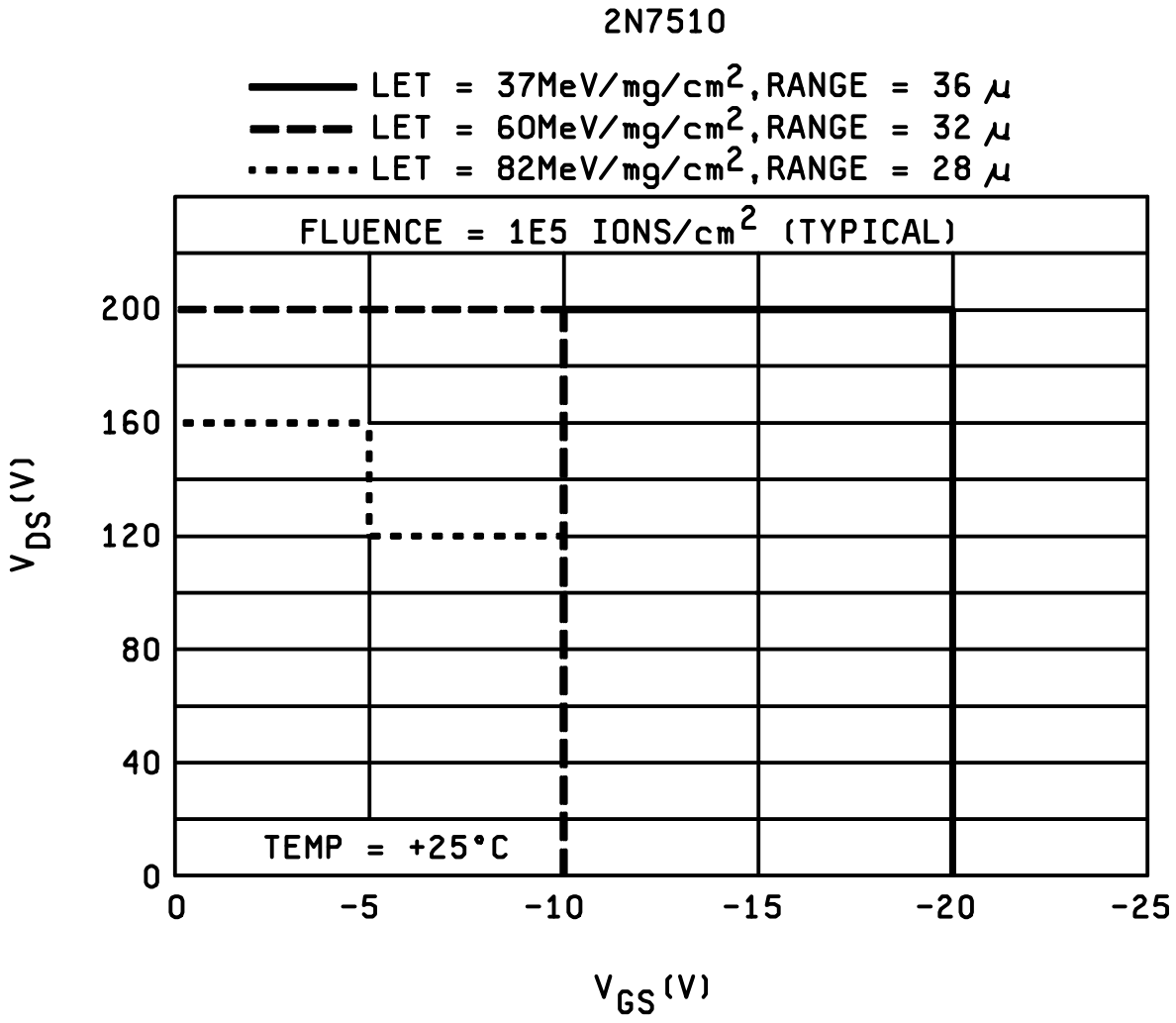

FIGURE 4. SEE safe operating area graphs – Continued.

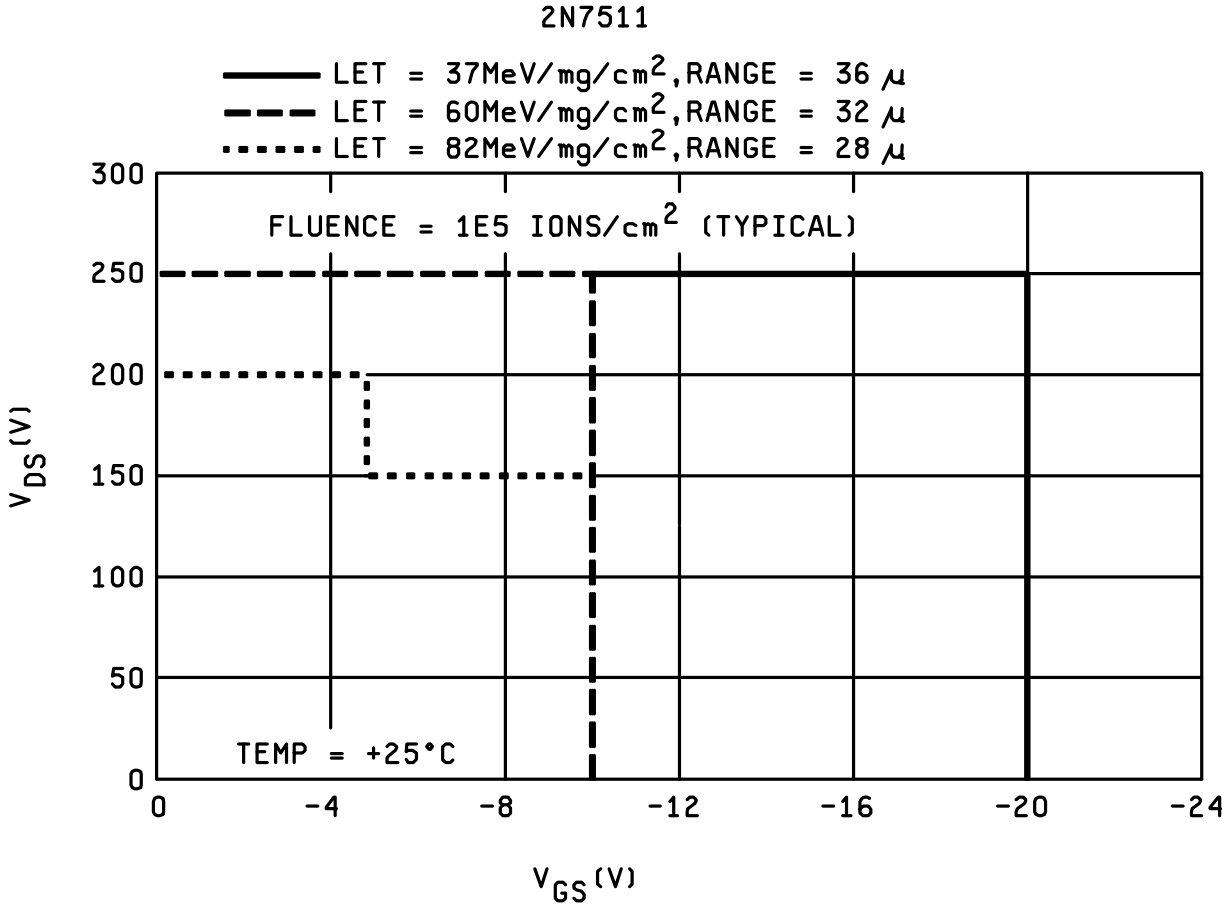

FIGURE 4. SEE safe operating area graphs – Continued.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).

c. The lead finish as specified (see 3.4.1).

d. Type designation and quality assurance level.

e. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List QML-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.5 Cross-reference list. The following table shows the generic P/N and its associated military P/N (without JAN and RHA prefix).

Generic P/N	Military P/N
FSGJ160 FSGJ260 FSGJ264	2N7509 2N7510 2N7511

Custodians:
Army - CR
Navy - EC
Air Force - 11
NASA - NA
DLA – CC

Preparing activity:
DLA - CC

(Project 5961-2406)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/687	2. DOCUMENT DATE 010314

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS) TRANSISTOR, N-CHANNEL SILICON TYPES 2N7509, 2N7510, AND 2N7511 JANTXVD, R AND JANSD, R

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510	DSN 850-0510	FAX 614-692-6939	EMAIL alan.barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888			

DD Form 1426, Feb 1999 (EG) Previous editions are obsolete WHS/DIOR, Feb 99